

ZOOLOGY.—*A review of the gorgonacean genus Placogorgia Studer, with a description of Placogorgia tribuloides, a new species from the Straits of Florida.*

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The extensive dredging operations of the U.S. Fish Commission steamer *Albatross* brought to light a great many zoological novelties, not a few of which are still awaiting description. Among these is a new gorgonian coral of the genus *Placogorgia*, which is now described and figured.

The genus *Placogorgia* as presently constituted contains four species in the Atlantic Ocean. All are characterized by calicular thorn-scales with a rather broad, branched, basal root and a stout, more or less lacinated but usually blunt spine, which projects above the surface of the calicles, giving them a thorny appearance. Although the thorn-scales of the four species are not identical, they are so similar that only exhaustive descriptions could point out the differences between them, and the species are distinguished mainly upon differences in the size and ornamentation of the cortical spindles.

The new species of *Placogorgia* that is the subject of this paper differs rather strikingly from the four previously known Atlantic species in the huge size of its calicular thorn-scales, which, moreover, have a quite acute spine and therefore bear a strong resemblance to the thorn-scales of *Paramuricea*. In this study, it has been necessary to reexamine all the Atlantic species of *Placogorgia* and to reappraise their position in respect to *Paramuricea* and related genera with calicular thorn-scales.

Genus *Placogorgia* Studer

Placogorgia Studer, 1887, Arch. Naturg. **53**(1): 56.
[No species described.]

Placogorgia Wright and Studer, 1889, *Challenger Zool* **31** (part 64): 113. (Type species, *Placogorgia atlantica* Wright and Studer, fixed by subsequent monotypy.)

not *Placogorgia* Nutting 1910, *Siboga* Exped. Monogr. **13b**: 76. [= *Discogorgia* Kükenthal.]

Placogorgia Nutting, 1912, Proc. U.S. Nat. Mus. **43**: 83.

Pseudothesea Kükenthal, 1919, *Ergebn. deutschen*

Tiefsee-Exped. **13**(2): 843. (Type species, *Thesea placoderma* Nutting, by original designation.)

As described, *Placogorgia* is difficult to separate from *Paramuricea* and *Echinomuricea*. Most of the species of *Placogorgia*, including some from the Indo-Pacific assigned to *Thesea* by Nutting (= *Pseudothesea* Kükenthal), have large, rude spindles that often become platelike, with strong external spines, and small, rather blunt calicular thorn-scales. *Paramuricea* has large, sharp thorn-scales (sometimes with the basal part much reduced), and small spindles usually without external spines—rarely flat scales with a central projecting process or boss. Unfortunately, the type species of *Placogorgia* has small cortical spindles with little or no indication of external spines, and rather sharp, but small, calicular thorn-scales (both characters like *Paramuricea*); and *Paracuricea multispina* Deichmann has cortical plates with a projecting process, and blunt calicular thorn-scales (characters approaching *Placogorgia*). Except for *E. atlantica*, *Echinomuricea* has stellate thorn-scales with a smooth or nearly smooth spine; its distribution is primarily Indo-Pacific. I am inclined to think that the *Echinomuricea atlantica* described and figured by Thomson (1927, p. 40, pl. 4, fig. 3) is actually Johnson's *Acanthogorgia grayi* (Johnson 1862, p. 195) rather than *atlantica*—compare the spicules!—and that it belongs to *Placogorgia* and not to *Echinomuricea* or *Paramuricea*. Its calicular thorn-scales and cortical plates are similar to those of the new *Placogorgia* described herein, but Thomson gives no measurements and the magnification of his figures is not indicated, so its identity remains uncertain. Kükenthal (1924, pp. 225–226) suggested that both *atlantica* and *grayi* are referable to *Paramuricea*. This disposition is contradicted in the case of *grayi* (Thomson's *atlantica*) by the large plates with several projecting spines, but could be valid for the true *atlantica*. There seem to be no species in the Atlantic Ocean that can be assigned to the genus

Echinomuricea as defined by most authors, which is characterized by calicular thorn-scales of a particularly distinct type.

Nutting (1910) described a number of East Indian species under the generic name *Placogorgia*, but most of them have been referred to other genera, notably *Discogorgia* (Kükenthal 1924, p. 212). He also described some muriceids with calicular thorn-scales and large, spinose cortical spindles and plates, which he placed in *Thesea*. Since they had nothing to do with the original *Thesea* of Duchassaing and Michelotti, Kükenthal in 1919 established for them the genus *Pseudothesea*, with *Thesea placoderma* Nutting as its type species. The character of its calicular thorn-scales leaves no doubt that *T. placoderma* is congeneric with *Placogorgia atlantica* Wright and Studer, and its cortical plates are not unlike those of *Placogorgia rudis* Deichmann. Most, perhaps all, of the other species described by Nutting in his monograph of the *Siboga* Muriceidae belong to other genera. *Thesea sanguinea* and *T. simplex*, of which I have seen type material, are referable because of their thorn-scales (which are of the "leaf-club" type) to *Echinogorgia*, a genus which perhaps should be ranked among the Plexauridae (Bayer, 1958, pp. 43, 48).

The paramuriceid species characterized by thorn-scales in the calicle are a closely interrelated complex, within which the generic distinctions—if such exist—must be drawn upon highly arbitrary grounds, at least until detailed studies can be made upon all pertinent type specimens. Until adequate studies can be undertaken there is no alternative but to recognize at least the most distinct of the genera that have been established. These genera are based mostly upon the form of the calicular thorn-scales. The thorn-scales of some genera, such as *Villogorgia*, *Trachymuricea*, and *Echinogorgia* (which possibly belongs in quite another family), are very distinctive, whereas those of other genera are only modifications of a simple, basic type, between which it is almost impossible to draw hard and fast boundaries.

The accompanying chart (Fig. 1) shows the major types and varieties of calicular thorn-scales (A–G) and cortical sclerites (H–N) found in the genera of Paramuriceidae sensu lato. (Excluded are *Bebryce* and *Acanthacis*, which are so distinctive that they need not enter into the present discussion.) The combinations of these

types that occur in the various genera are indicated by the numbered connecting lines.

CALICULAR THORN-SCALES

A. The *Menella*-type (genus *Menella* Gray: Kükenthal, 1924, p. 184).—A single smooth, tapered spine rises from a root-part consisting of irregularly diverging branches. So far as I can tell from the literature, this type is always associated with cortical spindles that may produce strong external spines (J). I have seen only *Menella rubescens* Nutting, whose thorn-scales are illustrated (A); final definition of the genus will depend upon a reexamination of the type species, *M. indica* Gray, the holotype of which must be in the British Museum of Natural History.

B. The *Echinomuricea*-type (genus *Echinomuricea* Verrill: Kükenthal, 1924, p. 185).—A single smooth, tapered spine originates abruptly from a root-part consisting of four or five widely diverging branches, the whole producing a stellate body. These are usually, if not always, combined with simple, symmetrically sculptured spindles in the cortex (K). Similar thorn-scales, but with shorter projecting spine, are found in the genus *Eubrandella*, established by Deichmann (1936, p. 128) to replace Verrill's *Lisso-gorgia*, which was based on a single specimen said to have come from Florida; nothing like it has ever again been found in Florida, suggesting that it may have originated elsewhere—most likely in the Indo-Pacific. It resembles some of the species of *Echinomuricea* from that region.

C. The *Paramuricea*-type (genera *Paramuricea* Kölliker and *Placogorgia* Studer: Deichmann, 1936, pp. 134, 141).—Large thorn-scales with a stout, acute, more or less aculeate spike arising from a complicated, branched or lobed basal root. In combination with very large spindles and plates with (I) or without (H) spines, it is found in *Placogorgia japonica* (6) and *P. tribuloides* (3); with smaller spindles, sometimes knee-bent, it occurs in *Paramuricea placomus* (7).

D. The *Villogorgia*-type (genus *Villogorgia* Duchassaing and Michelotti, including *Acamptogorgia* Wright and Studer, *Brandella* Gray, *Paramcamptogorgia* Kükenthal, and *Perisceles* Studer, all synonyms: Aurivillius, 1931, p. 204).—A projecting part that consists of a cluster of fingerlike processes, or thin radiating folia, arises

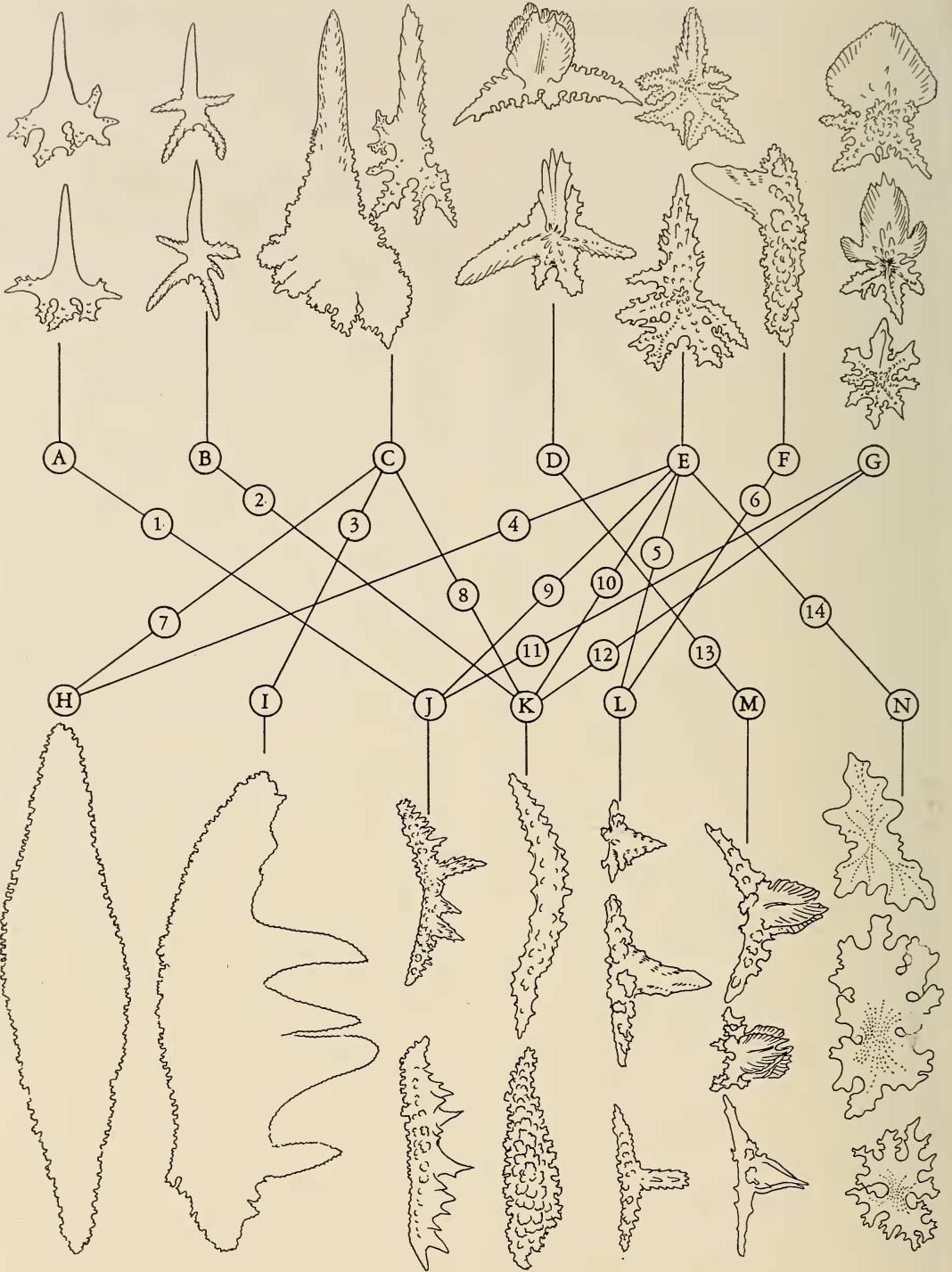


FIG. 1.—(See opposite page for legend).

from a widely diverging pair of flattened roots curved to fit the calicular walls. The various modifications that prompted the establishment of several genera were shown by Aurivillius (1931) to represent but a single type of spicule. Always associated with small 4-armed bodies having a pyramidal or winged central process (M, middle figure), sometimes with two arms suppressed to form a spindle with a median projection (M, top and bottom figures).

E. The *Placogorgia*-type (genera *Placogorgia* Studer and *Paramuricea* K lliker: Deichmann, 1936, pp. 134, 141).—Similar to the *Paramuricea*-type but usually the root is more strongly developed laterally and somewhat curved to fit the calicular wall, and the spine is thick, comparatively blunt, and conspicuously serrated or lacinated. Usually smaller than the typical thorn-scales of *Paramuricea* (C, upper figure) but occasionally surpass them in size, in which cases the root is more complicated and its branches coalesce more or less completely. In *Placogorgia* they are found in combination with simple spindles both small (K) and excessively large (H), large and small unilaterally spinose spindles (I, J, and L, lower figure), and marginally lobate scales (N, lower figure). Some species of *Paramuricea* have *Placogorgia*-type thorn-scales combined with lobate scales (N, the two upper figures), indicating that some generic allocation may be necessary.

F. The *Trachymuricea*-type (genus *Trachymuricea* Deichmann, 1936, p. 132).—The lacinated spine projects obliquely from a root that is only a simple spindle. Always in combination with small spindles having a conical external process (L, upper two figures) much like some of the cortical sclerites of *Villogorgia*. Only two species known at present, both of them further distinguished from species of *Paramuricea* and *Villogorgia* by a very high collaret.

G. The *Echinogorgia*-type (genera *Echino-*

gorgia K lliker, *Plexauroides* Wright and Studer, and *Paraplexaura* K kenthal: K kenthal, 1924, pp. 124, 130, 198).—A simple, stellate type of thorn-scale in which the projecting spine is greatly expanded into a thin leaf as in *Echinogorgia* and *Plexauroides* (three stages of modification are shown in G, bottom to top) and sometimes much thickened as in *Paraplexaura*. Since it is possible to trace the development of the foliate thorn-scales found in *Plexauroides* and some species of *Echinogorgia*, and the massive thorn-scales of *Paraplexaura* from the simple, stellate type of some *Echinogorgias*, it seems obvious that these genera are inseparable. The thorn-scales may be the predominant type of sclerite, or they may be combined with simple or unilaterally developed spindles (I and K). The generic distinctions are somewhat vague and dependent largely upon the development of the anthocodial armature, which is said to relegate *Echinogorgia* to the Paramuriceidae, and *Plexauroides* and *Paraplexaura* to the Plexauridae. Inasmuch as the anthocodial spiculation may be reduced in those species of *Echinogorgia* that have a thick rind into which the polyps retract fully, just as it is in the species of *Plexauroides* and other plexaurids that have thick rinds, it is a character of no value at the generic and familial levels. At this time it remains a moot point whether all of these species should be transferred to one family or the other; it is certainly improbable that they will continue to span two families.

CORTICAL SCLERITES

The basic type of cortical spicule is the simple spindle (K), which may grow excessively large (H), and by flattening and expansion of the margins develop into thick plates or thin scales (N). Simple spindles usually occur even in those species that have characteristically modified cortical sclerites, although in certain species they

FIG. 1.—Types of calicular thorn-scales (A–G) and cortical sclerites (H–N), and their various combinations (1–14): A, Calicular thorn-scales of *Menella rubescens*; B, of *Echinomuricea indomalaccensis*; C, of *Placogorgia tribuloides* (left) and *Paramuricea placomus* (right); D, of *Villogorgia zimmermani* (above) and *V. nigrescens* (below); E, of *Placogorgia tenuis* (above) and *P. atlantica* (below); F, of *Trachymuricea hirta*; G, of *Echinogorgia flexilis* (top and middle) and *E. pseudosassapo* (bottom); H, cortical sclerite of *Placogorgia mirabilis*; I, of *Placogorgia tribuloides*; J, of *Placogorgia rudis* (above) and *Thesea flexilis* (below); K, of *Paramuricea placomus* (above) and *Placogorgia atlantica* (below); L, of *Trachymuricea k kenthalii* (top and middle) and *Placogorgia tenuis* (bottom); M, of *Villogorgia zimmermani* (top and middle) and *V. nigrescens* (bottom); N, of *Paramuricea grandis* (top), *P. echinata* (middle), and *Placogorgia dendritica* (bottom). 1, spicular combination found in the genus *Menella*; 2, in *Echinomuricea*; 3, in *Placogorgia* (some species); 4, in *Placogorgia* (some species); 5, in *Placogorgia* (some species); 6, in *Trachymuricea*; 7, in *Placogorgia* (some species); 8, in *Placogorgia* and *Paramuricea* (some species); 9, in *Placogorgia* (some species); 10, in *Placogorgia* (some species); 11, in *Echinogorgia*; 12, in *Echinogorgia*; 13, in *Villogorgia*; 14, in *Paramuricea* and some species of *Placogorgia*.

may be largely suppressed by the thorn-scales of the calicular region, which then dominate throughout the rind (*Echinomuricea* and *Echinogorgia*). A common sculptural modification found in several genera and species is the unilaterally spinose spindle (J, L) which may become very large (I).

It may be useful to summarize the types of thorn-scales in the form of a dichotomous key to serve as a guide to the holaxonian genera having these peculiarly modified sclerites. As in the discussion above, *Bebryce* is not included because its superficial layer of rosettes and deeper layer of stellate plates render it absolutely unmistakable.

1. Cortex consisting of a single layer of spicules in the form of large, flattened spindles or plates. Thorn-scales around calicular aperture with a stout, rough, sometimes branched spine arising from a rather small, tuberculate base
Genus *ACANTHACIS* Deichmann
Cortex consisting of an outer layer of spicules, large or small, and a more or less complete inner layer of smaller spicules surrounding the axis. 2
2. Calicular thorn-scales noticeably broader than high, the root-part developed mostly at right angles to axis of calicle, with two main, spreading branches curved to fit the calicular wall; projecting portion consisting of several radiating folia or a lacinated, digitate process (Fig. 1, D). Cortex containing 4-armed bodies with a pyramidal, sometimes foliate central process; sometimes modified into simple spindles with median process (Fig. 1, M)
Genus *VILLOGORGIA* Duchassaing and Michelotti
Calicular thorn-scales typically higher than wide, not with two main diverging roots curved to fit the calicular walls. 3
3. Calicular thorn-scales are spindles with an obliquely set, more or less lacinated, pyramidal process near the distal end (Fig. 1, F)
Genus *TRACHYMURICEA* Deichmann
Calicular thorn-scales with a flattened, branched, lobed or platelike base. 4
4. Projecting portion of the calicular thorn-scales is usually a single spine. 5
Projecting portion of the thorn-scales is a foliate expansion sometimes lobed or cleft into broad fingers (Fig. 1, G), sometimes thickened into a massive head. . Genus *ECHINOGORGIA* Kölliker
5. Projecting spine of the calicular thorn-scales is a smooth or nearly smooth, tapered spike. . 6
Projecting spine of the thorn-scales is an echinulate or lacinate digitate process. 7

6. Projecting spike of calicular thorn-scales gradually merging into root portion, which consists of several irregularly divided branches (Fig. 1, A) Genus *MENELLA* Gray
Projecting spike of thorn-scales abruptly set off from the root portion, which consists of four or five widely diverging, slender branches (Fig. 1, B) Genus *ECHINOMURICEA* Verrill
7. Root portion of the calicular thorn-scales consists of several tuberculate lobes more or less completely fused together; projecting spine echinulate or strongly lacinate (Fig. 1, E). Cortical plates and spindles often with one or more strong spines. . Genus *PLACOGORGIA* Studer
Root portion of the thorn-scales consists of several diverging branches not extensively fused together; projecting spine echinulate (Fig. 1, C, right hand figure). Cortical spindles usually without spinous projections
Genus *PARAMURICEA* Kölliker

PLACOGORGIA TRIBULOIDES, n. sp.

Figs. 2-9; 15

Diagnosis.—Calicular thorn-scales nearly 2 mm in length, projecting spine about 1 mm. Cortical spindles large (1.5 mm+), flattened, especially near branch tips, with several stout projecting spines. A single pair of large bent spindles and some small accessory rods in each opercular sector; collaret with 3-6 rows of transverse spindles. Branching dichotomous.

Description.—The type is a small, nearly complete colony measuring 5 cm from base to tip of the tallest branch. Ramification is in one plane and dichotomous; the main stem bifurcates within 5 mm of the base and both branches again bifurcate at about 10 mm from the first division. Further dichotomies are asymmetrical, since not all the branches subdivide. The trunk has a diameter of 2.5 mm, the major branches 1.5 mm (exclusive of calicles), and the terminal twigs about 1.0 mm (excluding calicles). Most of the calicles are inclined toward one face of the colony (the "front"), and are closely set, their bases almost touching one another. The calicles are low cylinders filled with very stout, acute, imbricating thorn-scales (Fig. 2). The anthocodiae are armed with a prominent, conical operculum consisting of a ringlike collaret usually 3-5 spicules in height, surmounted by eight points each made up of one pair of large, bent spindles of subequal size, and some small accessory rods.

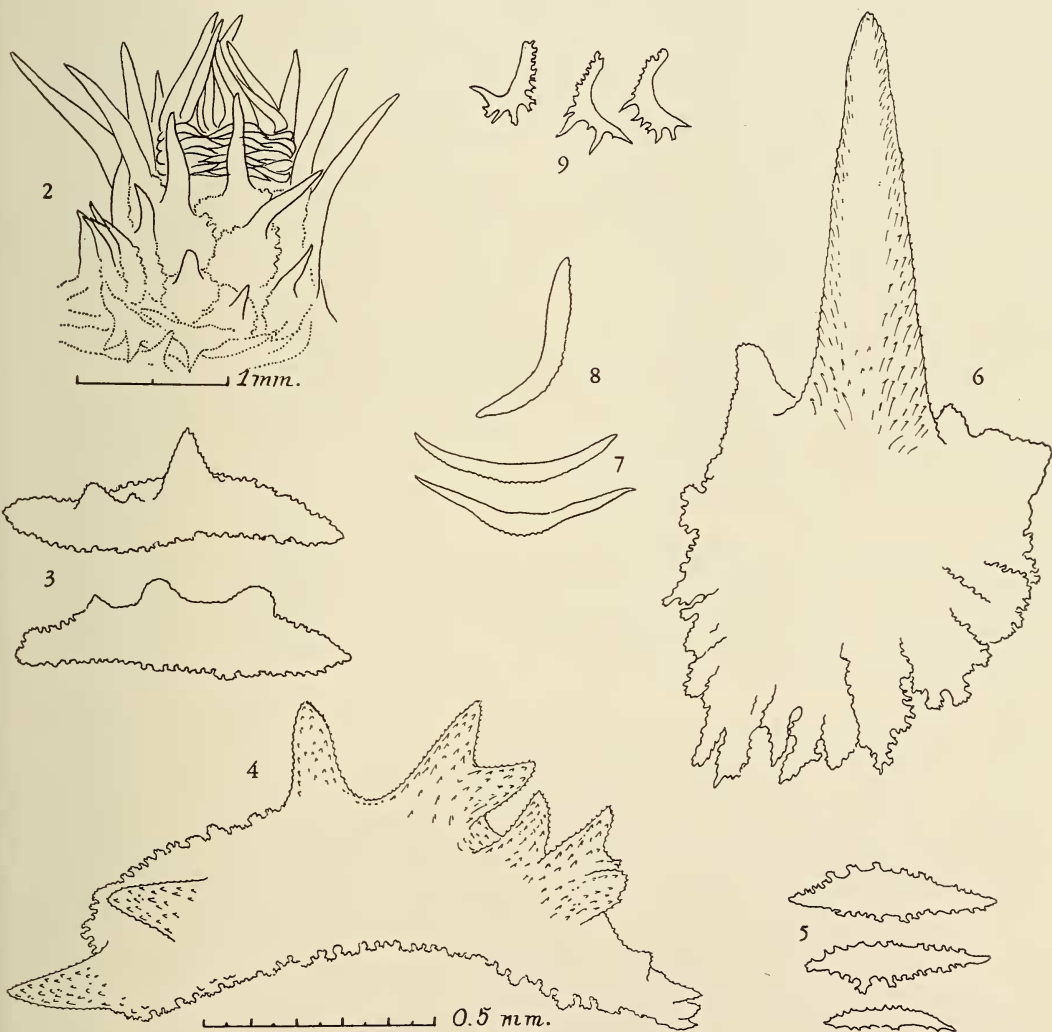
The coenenchyme has a dense outer layer of glassy, irregularly tuberculate spindles, the larg-

est of which bear one to several strong, sharp, projecting spikes. Toward the branch tips some of these become broad and platelike, with several spines, closely resembling the sclerites of certain species of *Paracis*. Between and beneath the large outer sclerites there are small, irregular spindles that form a discontinuous inner layer.

Spicules.—(a) Cortex: roughly tuberculate, coarse spindles with one or several outward projecting, finely echinate processes (Fig. 3). Near the calicles these sclerites increase in size, reaching a length of 1.5 mm or longer, and bearing

several stout processes some of which may be marginal (Fig. 4). Toward the branch tips, the large deposits may become quite broad and platelike, after the manner of *Paracis*. Lying between and beneath the large deposits are numerous smaller spindles, more or less flattened and with irregular edges (Fig. 5), forming a discontinuous axial sheath.

(b) Calicles: large thorn-scales with a stout, sharp, echinulate spine arising from the distal margin (Fig. 6). The broad, tuberculate basal part of the scale may have a width of 0.8 mm, and the spine may exceed a length of 1 mm.

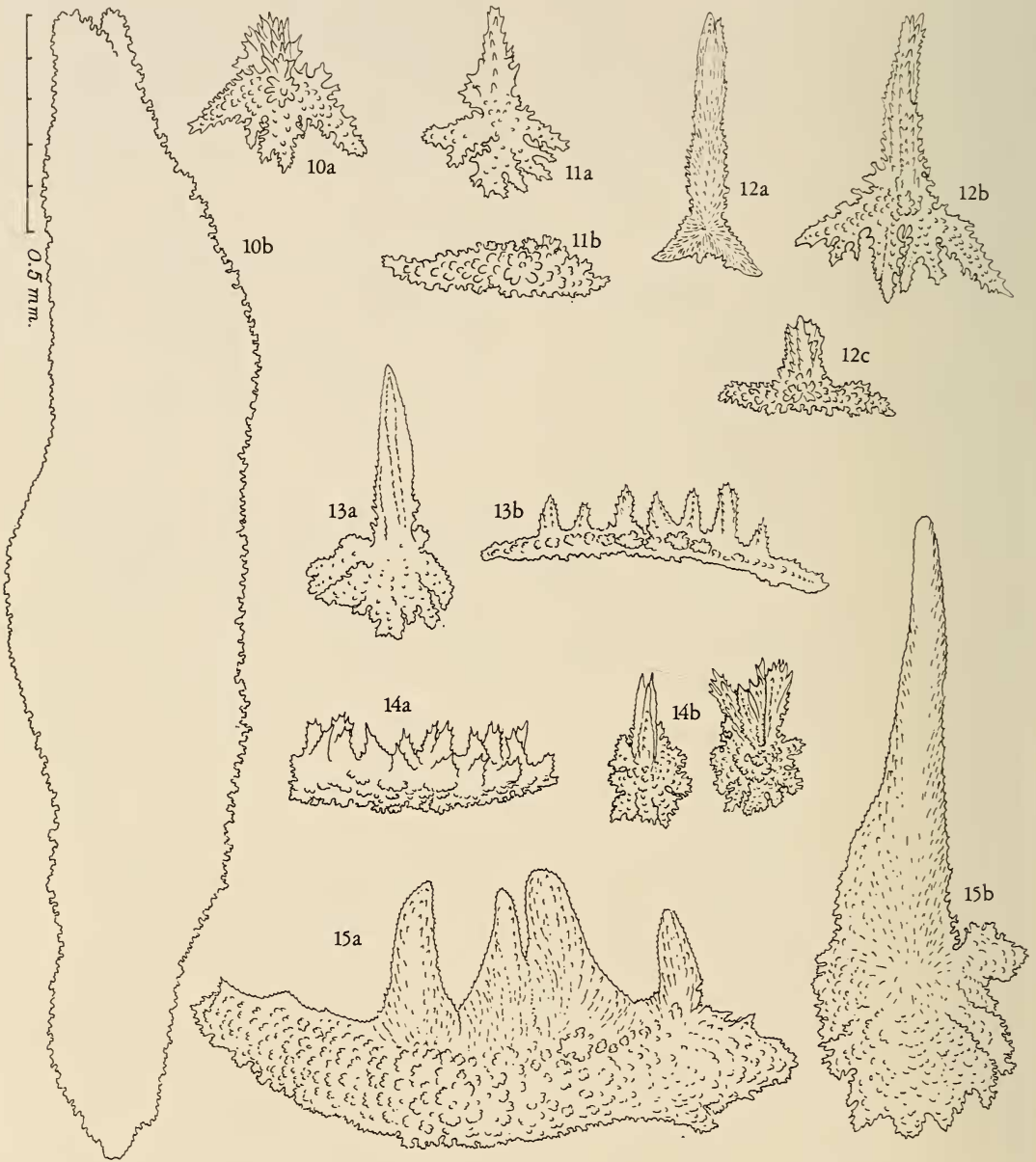


Figs. 2-9.—*Placogorgia tribuloides*, n. sp.: 2, Side view of calicle with operculum; 3-4, cortical sclerites; 5, spindles of axial sheath; 6, calicular thorn-scale; 7, spindles of collarlet and 8, of points; 9, spicules from the tentacles. All spicules enlarged to scale shown beneath Fig. 4.

Their appearance *in situ* on the calices is shown in Fig. 2.

(c) Polyps: the collaret contains about 5 transverse rows of curved spindles, in smaller polyps as few as 3 rows, in larger individuals as many as 5 or occasionally 6 rows. In polyps of average size they have a length of 0.5 mm (Fig.

7). Surmounting the collaret, the eight opercular points contain one pair of large, bent spindles about 0.5 mm long (Fig. 8) and another pair or two of smaller but similar accessory rods. The appearance of the closed operculum, partly retracted within the calicle, is shown also in Fig. 2. The tentacles contain the small, flat, bent rod-



FIGS. 10-15.—Spicules of *Placogorgia*: *P. mirabilis* (10a, calicular thorn-scale; 10b, cortical spindle); *P. atlantica* (11a, calicular thorn-scale; 11b, cortical spindle); *P. tenuis* (12a, crutch-shaped rod from opercular sector; 12b, calicular thorn-scale; 12c, cortical sclerite); *P. rudis* (13a, calicular thorn-scale; 13b, cortical sclerite); *P. placoderma* (14a, cortical sclerite; 14b, calicular thorn-scales); *P. tribulooides* (15a, cortical sclerite; 15b, calicular thorn-scale).

lets with lacinated edge that are characteristic of paramuriceid genera (Fig. 9).

Color.—White, the light brown axis showing through the translucent spicules.

Holotype.—U.S.N.M. no. 10204. Straits of Florida, off Havana, Cuba: 23° 10' 39" N., 82° 20' 21" W., 204 fathoms, January 19, 1885; collected by tangles. *Albatross* station 2335.

Remarks.—Four other species of *Placogorgia* are known to occur in the Atlantic: *Placogorgia atlantica* Wright and Studer, *P. mirabilis* Deichmann, *P. rudis* Deichmann, and *P. tenuis* (Verrill). *Placogorgia tribuloides* differs from all these species in the large size of its thorn-scales, which approach the type found in *Paramuricea*. That genus, however, lacks the large cortical spindles or plates with serried processes. *P. tribuloides* further differs from *P. mirabilis* in the absence of excessively large (4 mm) spindles in the cortex; from *P. rudis*, which has similar cortical spindles, by its large and sharp thorn-scales; and from *P. tenuis* by the frequent development of several spines on the cortical spindles and the lack of the single large, crutch-shaped rod in the opercular segments. These differences may be set forth in the form of a dichotomous key:

1. Cortex contains large spindles up to 4 mm in length, clearly visible to the unaided eye (Fig. 10b). Anastomosis of branches frequent
Placogorgia mirabilis Deichmann
 Largest spindles of cortex less than 2 mm in length. Anastomosis of branches infrequent or absent.....2
2. Operculum usually with a single large, crutch-shaped rod (Fig. 12a) in each sector. Cortical spindles up to approximately 0.6 mm in length, usually with only one projecting process (Fig. 12c), sometimes none
Placogorgia tenuis (Verrill)
 Operculum with at least two large, bent spindles in each sector, not a single crutch-shaped rod.....3
3. Cortical spindles small, usually not exceeding a length of 0.5 mm, without a row of prominent external spines (Fig. 11b). Thorn-scales 0.5 mm long, spine 0.3 mm, sharp and aculeate (Fig. 11a)
Placogorgia atlantica Wright and Studer

Cortical spindles larger, up to 1.5 mm in length, many of them with a row of spines (Figs. 13b, 15a)4

4. Calicular thorn-scales large, 1.7 mm over-all, with a strong, sharp spine as much as 1 mm in length (Fig. 15b)

Placogorgia tribuloides, n. sp.
 Calicular thorn-scales smaller, usually not more than 0.5 mm over-all, spine stout, mostly blunt or moderately sharp (Fig. 13a), commonly 0.2–0.25 mm long and rarely up to 0.4 mm, often with several prominent terminal subdivisions.....*Placogorgia rudis* Deichmann

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